

CLAIMS

1. A thermally enhanced fluid composition, comprising:
an effective amount of a selected neat fluid having a selected thermal conductivity;

5 an effective amount of a selected carbon nanomaterial dispersed into said selected neat fluid, said selected carbon nanomaterial having a thermal conductivity greater than the thermal conductivity of said selected neat fluid in which the carbon nanomaterial is dispersed; and

10 an effective amount of at least one chemical dispersing agent;

2. The composition of Claim 1 wherein said carbon nanotube is either single-walled, or multi-walled, with typical aspect ratio of 500-5000.

15 3. The composition of Claim 1 wherein said carbon nanotube is surface treated to be hydrophilic at surface for ease of dispersing into the aqueous medium.

4. The composition of Claim 1 wherein the said dispersant is soluble in the said liquid medium.

20 5. The composition of Claim 1 wherein said liquid medium is selected from the group consisting of a petroleum distillate and a synthetic petroleum oil.

6. The composition of claim 1, wherein said chemical dispersing agent is a surfactant

7. The composition of claim 6, wherein said surfactant is selected from the group consisting of a ionic surfactant and a mixture of a nonionic and ionic surfactant.

5 8. The composition of claim 1, wherein said dispersing agent is a dispersant-detergent (DI) additive package.

9. The composition of Claim 1 wherein said liquid medium is a water based solution.

10. The composition of claim 9, wherein said dispersant is a nonylphenoxypoly(ethyleneoxy)ethanol-type surfactant.

10 12. The composition of claim 1 wherein said fluid is a uniform dispersion in a form as a gel or paste.

14. The composition of claim 1, wherein said fluid is a grease.

15. The composition of claim 1, wherein said carbon nanomaterial comprises carbon nanotubes and graphite nanoparticles.

15 16. The composition of claim 1, wherein said carbon nanomaterial is selected from the group consisting of carbon nanotubes, graphite nanoparticles, and combinations thereof.

20 17. The thermally enhanced fluid composition of claim 1, wherein an effective amount of a selected carbon nanomaterial to obtain the desired thermal enhancement is up to 20 percent by weight.

25 18. The thermally enhanced fluid composition of claim 1, wherein an effective amount of a selected carbon nanomaterial to obtain the desired thermal enhancement is from 0.001 to 10 percent by weight.

19. The thermally enhanced fluid composition of claim 1, wherein an effective amount of a selected carbon nanomaterial to obtain the desired thermal enhancement is from 0.01 to 5 percent by weight.

5 20. The thermally enhanced fluid composition of claim 1, including a selected amount of oil.

21. The thermally enhanced fluid composition of claim 1, including a selected amount of water.

10 22. The thermally enhanced fluid composition of claim 1, wherein said effective amount of a selected carbon nanomaterial is up to 90 percent by weight.

23. The thermally enhanced fluid composition of claim 1, wherein said effective amount of a selected carbon nanomaterial is up to 10 percent by weight.

15 24. The thermally enhanced fluid composition of claim 1, wherein said effective amount of a selected carbon nanomaterial is from 0.001 to 2.0 percent by weight..

20 25. The thermally enhanced fluid composition of claim 1, wherein said selected carbon nanomaterial has a thermal conductivity exceeding 80W/m-K.

26. The thermally enhanced fluid composition of claim 1, wherein said selected carbon nanomaterial has a thermal conductivity exceeding that of said selected neat fluid.

25 27. The thermally enhanced fluid composition of claim 1, wherein said neat fluid comprises a petroleum liquid medium selected

from the group consisting of a petroleum distillate, a synthetic petroleum oil, a grease, a gel, a oil-soluble polymer composition, and combinations thereof.

28. The thermally enhanced fluid composition of claim 1, wherein said neat fluid is selected from the group comprising Group I (solvent refined mineral oils), Group II (hydrocracked mineral oils), Group III (severely hydrocracked hydrogenated oils), Group IV (polyalphaolefins), and Group VI (esters, naphthenes, and polyalkylglycols), and combinations thereof.

29. The thermally enhanced fluid composition of claim 1, wherein said neat fluid is selected from the group of synthetic hydrocarbon oils, halo-substituted hydrocarbon oils, polymerized and interpolymerized olefins, polybutylenes, polypropylenes, propylene-isobutylene copolymers, chlorinated polybutylenes, poly(1-octenes), poly(1-decenes), alkylbenzenes, dodecylbenzenes, tetradecylbenzenes, dinonylbenzenes, di-(2-ethylhexyl)benzenes, polyphenyls, biphenyls, terphenyls, alkylated polyphenyls, alkylated diphenyl, ethers and alkylated diphenyl sulfides, and combinations thereof.

30. The thermally enhanced fluid composition of claim 1, wherein said neat fluid is selected from the group comprising the esters of dicarboxylic acids selected from the group consisting of phthalic acid, succinic acid, alkyl succinic acids and alkenyl succinic acids, maleic acid, azelaic acid, suberic acid, sebacic acid, fumaric acid, adipic acid, alkenyl malonic acids, with an alcohols selected from the group consisting of butyl alcohol, hexyl alcohol, dodecyl alcohol, 2-ethylhexyl alcohol, ethylene glycol diethylene glycol monoether, propylene glycol, dibutyl adipate, di(2-ethylhexyl) sebacate, di-hexyl fumarate, dioctyl sebacate, diisooctyl azelate, diisodecyl azealate, dioctyl phthalate, didecyl phthalate, dicicosyl sebacate, the 2-ethylhexyl diester of linoleic acid dimer, the complex ester formed by reacting one mole of sebacic

acid with two moles of tetraethylene glycol and two moles of 2-ethylhexanoic acid, and combinations thereof.

31. The thermally enhanced fluid composition of claim 1, wherein said neat fluid is selected from the group comprising esters made from C₅ to C₁₂ monocarboxylic acids and polyols and polyol ethers such as neopentyl glycol, trimethylolpropane, pentaerythritol, dipentaerythritol, tripentaerythritol, and combinations thereof.

32. The thermally enhanced fluid composition of claim 1, wherein said neat fluid is selected from a polyalphaolefins having a viscosity of up to 100 centistoke at 100°C.

33. The thermally enhanced fluid composition of claim 1, wherein said neat fluid is selected from the group of synthetic based oil ester additives consisting of polyolesters, diesters, dialiphatic diesters of alkyl carboxylic acids, di-2-ethylhexylazellate, di-isodecyladipate, di-tridecyladipate, and combinations thereof.

34. The thermally enhanced fluid composition of claim 1, wherein said neat fluid is selected from the group of diesters consisting of an aliphatic diester of a dicarboxylic acid, a dialkyl aliphatic diester of an alkyl dicarboxylic acid, a di-2-ethyl hexyl azelate, a di-isodecyl azelate, a di-tridecyl azelate, a di-isodecyl adipate, a di-tridecyl adipate, and combinations thereof.

35. The thermally enhanced fluid composition of claim 1, wherein said neat fluid is selected from a hydrogenated oil having a sulfur level less than 0.03 with saturates greater than or equal to 90 and a viscosity index of greater than or equal to 120.

36. The thermally enhanced fluid composition of claim 1,

wherein said neat fluid is a hydrogenated oil having a viscosity of from 2 to 60 CST at 100 degrees centigrade.

37. The thermally enhanced fluid composition of claim 1, wherein said neat fluid is a hydrogenated oil present in an amount of up to 99 percent by volume.

38. The thermally enhanced fluid composition of claim 1, wherein said neat fluid is selected from the water-based group consisting of an alcohol and its derivatives.

39. The thermally enhanced fluid composition of claim 1, wherein said neat fluid is selected from the water-based group consisting of an ethylene glycol, a propylene glycol, a methyl alcohol, an ethyl alcohol, a propyl alcohol, an isopropyl alcohol, and combinations thereof.

40. The thermally enhanced fluid composition of claim 1, wherein said dispersants are selected from the group consisting of an lipophilic hydrocarbon group, and a polar functional hydrophilic group.

41. The thermally enhanced fluid composition of claim 1, wherein said polar functional hydrophilic group is selected from the class of carboxylate, ester, amine, amide, imine, imide, hydroxyl, ether, epoxide, phosphorus, ester carboxyl, anhydride, or nitrile.

42. The thermally enhanced fluid composition of claim 1, wherein said dispersant is an ashless dispersant typically used in the petroleum industry selected from the group consisting of N-substituted polyisobutenyl succinimides and succinates, alkyl methacrylate-vinyl pyrrolidinone copolymers, alkyl methacrylate-dialkylaminoethyl methacrylate copolymers, alkylmethacrylate-polyethylene glycol methacrylate copolymers, and polystearamides.

43. The thermally enhanced fluid composition of claim 1, wherein said dispersant is an oil-based dispersants selected from the group consisting of alkylsuccinimide, succinate esters, high
5 molecular weight amines, Mannich base derivatives, phosphoric acid derivatives, polyisobutenyl succinimide-polyethylenepolyamine, polyisobutenyl succinic ester, polyisobutenyl hydroxybenzyl-polyethylenepolyamine, and bis-hydroxypropyl phosphorate.

44. The thermally enhanced fluid composition of claim 1,
10 wherein an effective amount of said dispersant present in an amount of from 0.001 to 30 percent by weight.

45. The thermally enhanced fluid composition of claim 1, wherein an effective amount of said dispersant present in an amount of from between 0.5 percent to 20 percent weight.

46. The thermally enhanced fluid composition of claim 1,
15 wherein an effective amount of said dispersant present in an amount of from between 2 to 6 weight percent by weight.

47. The thermally enhanced fluid composition of claim 1, wherein an effective amount of said nanomaterial present is in an
20 amount of 0.0001 up to 50 percent by weight.

48. The thermally enhanced fluid composition of claim 1, wherein said dispersant is selected from the group consisting of a high molecular weight polyamine dispersion inhibitor package, a high molecular weight succinimide dispersion inhibitor package, a mixed
25 dispersant comprising a high molecular weight succinimide and an ester, a bis-succinimide, a nonylphenoxy poly(ethyleneoxy), OLOA 9061 dispersant, LUBRIZOL 4999 dispersant, LUBRIZOL 9802A dispersant, LUBRIZOL 9802AC dispersant, INFINEUM C9231 dispersant, INFINEUM C9232 dispersant, INFINEUM C9235 dispersant, LUBRIZOL

QS154250 dispersant.

49. The thermally enhanced fluid composition of claim 1, including an effective amount of a viscosity improver selected from the group consisting of an olefin copolymers (OCP), a polymethacrylates (PMA), a hydrogenated styrene-diene (STD), a styrene-polyester (STPE) polymers, and an olefin copolymer.

50. The thermally enhanced fluid composition of claim 1, including an effective amount of at least one pour point depressant selected from the group consisting of an alkylnaphthalene, an acrylic copolymer, a polymethacrylate, a polyfumarates, a styrene ester, an oligomerized alkylphenol, a phthalic acid ester, an ethylenevinyl acetate copolymer, and other mixed hydrocarbon polymers.

51. The thermally enhanced fluid composition of claim 1, including an effective amount of a rust and oxidation inhibitor.

52. The thermally enhanced fluid composition of claim 1, including an effective amount of a demulsifier.

53. The thermally enhanced fluid composition of claim 1, including an effective amount of a foam inhibitor.

54. The thermally enhanced fluid composition of claim 1, including an effective amount of a seal swelling agent.

55. A method of thermally enhancing the conductivity of a fluid composition, comprising the steps of:
selecting a neat fluid having a selected thermal conductivity;
selecting a carbon nanomaterial;
dispersing said selected carbon nanomaterial having a thermal conductivity greater than the thermal conductivity of said selected

neat fluid in which the carbon nanomaterial is dispersed into said
neat fluid; and
adding at least one chemical dispersing agent thereto.

5 56. The method of thermally enhancing the conductivity of
a fluid composition of claim 55, including the step of pre-shearing
said dispersed nanomaterial solution.

10 57. The method of thermally enhancing the conductivity of a
fluid composition of claim 56, wherein said step of pre-shearing is
selected from the group consisting of creating a turbulent flow
through a nozzle, creating a turbulent flow thorough a high pressure
fuel injector, an ultrasonic device, and combinations thereof to
achieve a stable viscosity.

15 58. A method of thermally enhancing the conductivity of a
fluid composition, comprising the steps of:
selecting a neat fluid having a selected thermal conductivity;
selecting a carbon nanomaterial;
selecting at least one chemical dispersing agent;
dissolving said dispersant into said neat fluid forming a
liquid medium;
20 adding said carbon nanoparticle into said liquid medium while
being agitated or ultrasonicated.

59. The method of thermally enhancing the conductivity of
a fluid composition of claim 58, including the step of pre-shearing
said dispersed nanomaterial solution.

25 60. The method of thermally enhancing the conductivity of a
fluid composition of claim 59, wherein said step of pre-shearing is
selected from the group consisting of creating a turbulent flow
through a nozzle, creating a turbulent flow thorough a high pressure
fuel injector, an ultrasonic device, and combinations thereof to

achieve a stable viscosity.

61. A method of thermally enhancing the conductivity of a fluid composition, comprising the steps of:

selecting a neat fluid having a selected thermal conductivity;

5 selecting a carbon nanomaterial;

selecting at least one chemical dispersing agent;

dissolving said carbon nanomaterial into said neat fluid
forming a liquid medium;

10 adding said chemical dispersing agent into said liquid medium
while being agitated or ultrasonicated.

62. The method of thermally enhancing the conductivity of a fluid composition of claim 61, including the step of pre-shearing said dispersed nanomaterial solution.

15 63. The method of thermally enhancing the conductivity of a fluid composition of claim 62, wherein said step of pre-shearing is selected from the group consisting of creating a turbulent flow through a nozzle, creating a turbulent flow thorough a high pressure fuel injector, an ultrasonic device, and combinations thereof to achieve a stable viscosity.